4 Health Physics aspects of the Operation of the Oxide Conversion Facility

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The attached is an attempt to analyze our radiological experience in the subject areas. The aspects covered include floor contamination, airborne activity, in-vivo results and urine sample results. Some recommendations are made to perhaps better the health physics aspects of future operations at this facility.

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. HEALTH PHYSICS ASPECTS OF THE OPERATION OF THE
OXIDE CONVERSION FACILITY, JANUARY 1968 TO OCTOBER 1969

Introduction

The following report is an attempt on the part of the author to analyze the radiological aspects experienced during the approximate two years of operation of the modified oxide conversion facility. Recommendations are made for most of these aspects in an attempt to improve the radiological safety of the personnel working in these areas. During the period covered by this report (January 1968 to October 1969) the overall cooperation of all individuals connected with the operation and maintenance of the facility was very good. However, there were cases of individual disregard for their own radiological safety. A continuation of such practice can not be tolerated and should be cause for disciplinary action by the appropriate supervision.

Values on the graphs (except Graph 1), less than 0.1 of the units listed on the ordinates, were plotted as 0.1.

Contamination Control - Floor Area (Graph 1)

Starting with a relatively clean area in January 1968, the first three months of operation showed good contamination control as both the area index and the contamination index decreased during this period. From April until August a steady increase is noted for both values. The contamination index peaked at 2500 and the area index at 100%. From August 1968 until shutdown in early October 1969, both values remained fairly constant with the contamination index at 1500 and the area index at approximately 100%. This would indicate that major spreads were cleaned up but no day-by-day efforts were made to reduce the overall levels.

Greater effort must be expanded continually in order to keep the contamination levels at a lower value. This is particularly true of the loose contamination, Loose contamination becomes surface contamination on floor areas subject to heavy traffic, However, during 1969 when the floor contamination levels were fairly stabilized, both the production rate and the total production were increasing when compared with these values for 1968,

In-Vivo

There was a total of 17 employees, including supervisors, foremen and chemical operators, evaluated in the operations in-vivo program, In October 1968 the average body burden per employee was 104 micrograms of U-235 or 33% of one body burden. The in-vivo results in November 1969 showed that the average body burden per employee had dropped to 72 micrograms of U-235 or 23% of one body burden. The overall approximate two-year average was 86 micrograms of U-235 or 26% of one body burden.

There was a total of 25 employees, including foreman and maintenance personnel, evaluated in the maintenance in-vivo program. In October 1968 the average body burden per employee was 30 micrograms of U-235 or 9% of one body burden. The in-vivo results in November 1969 showed that the average body burden per employee was 46 micrograms of U-235 or 14% of one body burden. The overall approximate two-year average was 44 micrograms of U-235 or 14% of one body burden. The overall approximate two-year average body burden in micrograms of uranium for the operation personnel together with the two-year average d/m/100 ml of alpha activity in the urine samples submitted (discussed below) is as follows:

Employee	µg	d/m/100 ml
1	116	1.8
2	148	1.9
3	36	0.7
4	70	5.5
5	57	5.0
6	0	1.0
7	107	3.9'
8	115	2.5
9	78	0.9
10	71	4.9
11	143	3.6
12	176	4.0
13	67	4.3
14	90	4.5
15	114	12.9
16	58	2.3
17	15	2.1

The overall approximate two-year average body burden in micrograms of uranium for the maintenance personnel together with two-year average d/m/100 ml of alpha activity in the urine samples submitted (discussed below) is as follows:

Employee	µg	d/m/LOO ml
1	40	1.6
2	37	0.1
3	13	1.2
4	67	7.2
5	93	7.0
6	130	11.4
7	92	405
8	106	2.8
9	29	0.2
10	72	1.5
11	0	1.2
12	23	0.9
13	51	0.6
14	13	1.4
15	34	6.1
16	50	0.9
17	9	0.3
18	72	0.7
19	0	0.3
20	0	0.2
21	36	0.4
22	13	0.5
23	21	0.9
24	105	15.8
25	0	0.8

Urine Sample Program (Graph 12)

The urine sample results of the 17 operation employees evaluated in the in-vivo program were used to determine the data for this report. The peaks in the urine sample plot follow closely the peaks in the average airborne activity curve (Graph 1), however, the urine peaks appear approximately a week later as would be expected. Most of the high airborne activity experienced by the operations personnel was of the "unplanned and uncontrolled" type and was generated in the Cold Trap Area by faulty cylinder valves and ruptured pigtails. This material being soluble in the body fluid gives the typical high peaks and sharp drops seen on the curve. However, most of these high peaks could have been avoided by'incorporating in the operational procedures the requirement of wearing respiratory protection when connecting and disconnecting cylinders. The higher 1969 average was probably caused by the fact that more high assay material was processed during this period.

The urine sample results of the 25 maintenance employees evaluated in the in-vivo program were used to determine the data for the maintenance personnel urine plot (Graph 12). The maintenance urine plot follows the operation urine curve remarkably well considering that most of the high airborne activity exposure for the maintenance personnel was in "planned and controlled" incidents where respiratory protection was required. There were a few cases where maintenance employees were in the area when "uncontrolled and unplanned" high airborne activity occurred. The high maintenance urine sample average for 1969 compared to 1968 could have only resulted from the maintenance employees not wearing the required respiratory protection or from an improper fit of the same. There was more maintenance work performed in 1969 than in

1968 which leads to a higher probability for exposure to high airborne activity.

Airborne Activity

The airborne activities presented in this report are based on the results obtained from the continuous air samples. The air sample is obtained by pulling air through filter paper mounted on an IBM card. The card is mounted in a holder. A central air jet services all eight of the locations in the Oxide Conversion Area. Three hundred and thirty-six cubic feet of air is drawn through the filter paper per shift. The eight locations are as follows: Cold Trap - 2, Tower Room - 3, Oxide Unloading - 1, Calciner Area - 1, H-Area - 1. The sample cards are normally changed each shift, Natural background activity is allowed to decay and the samples are then counted for alpha activity in the automatic scintillation counter,

All the airborne activity results presented exclude greater-than-PAL results due to "planned and controlled" incidents. An example of this would be maintenance personnel removing or replacing the feed screw. This job would be planned with the personnel involved vearing protective clothing and respiratory devices. The area involved would be restricted to employees so protected.

The airborne activity experience in the Oxide Conversion Areas was analyzed on both a radiation base ($d/m/ft^3$) and on an equivalent weigh',* of uranium base ($\mu g/ft^3$). Plant allowable limit on a radiation base is 3 $d/m/ft^3$. Plant allowable limit on an equivalent weight base varies with the assay of

'Equivalent Weight - The higher the assay, the less weight of uranium required to give the same internal radiation dose.

the material being processed and these values are presented with the weekly average airborne results.

Gold Trap (Graphs 2 and 3)

More incidents of greater-than-PAL airborne activity was experienced in this area than in any of the other areas. The majority of these incidents were due to faulty cylinder valves and ruptured pigtails. These types of problems allow a large amount of material to escape to the immediate area and also to the other areas before remedial measures can be instituted. Unfortunately most of these incidents occurred when high assay material was being processed.

Of the three tower burn-outs experienced, only one (week 8, 1969) seriously effected the airborne activity in the Cold Trap Area. The overall cold trap airborne activity graph is similar in shape to the other area graphs. From January 1968 through June 1968 the airborne activity decreased (best seen on graph 2). During the remaining 26 weeks of 1968, greater-than-PAL activity was experienced in 10 of the weeks. This trend continued for the first 17 weeks of 1969 with greater-than-PAL being experienced in eight of these weeks. In only one week (week 8, 1969), as mentioned above, was the cause of the greater-than-PAL results generated outside of the Cold Trap Area. The remaining weeks of 1969 show only one case of greater-than-PAL activity and the curve again showed a decrease. Most of the trouble experienced during the last of 1968 first of 1969 period was, as mentioned earlier, caused by faulty cylinder valves and pigtails. However, as shown on graph 2, the production was increasing. This means that more cylinders were being connected and disconnected and thus more chances of increasing airborne activity. In addition to the above, cold trap plugging by foreign materials in the system was being experienced and after more than six months of operations the equipment needed continual maintenance. Both the radiation (graph 3) and the weight (graph 2) show the same characteristics mentioned above. However, graph 2 better depicted the effect of changing assays.

Recommendations

1. It is realized that an extensive and very sophisticated type of ventilation would be required to contain any major release in the withdrawal area.of the cold trap. However, it is felt that the present ventilation system could be better utilized by being moved to a position above the cylinder pigtail connections and adding a funnel-shaped end to the ventilation opening to increase the effective area of the system.

2. It is further recommended that the operators wear assault masks when connecting or disconnecting cylinders in accordance with Operating Specification - "Safety Precautions UF_6 Cylinder" (CN 11.0-1).

Tower Room (Graphs 4 and 5)

Of the ten weeks in which greater-than-PAL airborne activity was experienced, three were attributed to incidents outside the area (three large releases in the Cold Trap Area). On three occasions a hole was burned in the upper section of the flame tower causing a release of PG and oxide. The remaining four incidents were caused by other types of equipment failure. The overall profile of the graphs of the airborne activity in this area looks similar to the cold trap graphs. The Tower Room activity is somewhat lower in intensity when compared with the cold trap. From week 15, 1969 until week 40, 1969 the airborne activity increased on a weight base due to the fact that the assay of the material being processed was changing. However, there was no case of greater-than-PAL airborne activity during this period.

Considerable airborne activity greater than PAL was generated in the Tower Room during periods of maintenance work. (This airborne activity is not reflected on these graphs.) There was considerable work connected with design changes and modifications to the flame tower system(s) which created airborne activity* However, there were many cases where the amount of activity could have been lessened and/or avoided by more strict adherence to operating procedures,

Recommendations

1. The proposed dual vacuum system should greatly reduce the cases of high airborne activity when maintenance work and operational activity are being performed at the same time. It is recommended that the second vacuum system be used to the fullest extent possible to keep the inside of the glove boxes clean. This would greatly reduce the potential for airborne activity when it is necessary to perform maintenance work inside an open glove box.

2. It is recommended that the operational procedure concerning the removal of gloves and ports be more stringently administered, and removed only when necessary.

3. It is recommended that the operational procedure covering the bagging of tool and equipment before removal from a glove box be strictly followed.

Oxide Unloading Room (Graphs 6 and 7)

The airborne activity plot in the area has the same profile as both the Cold Trap and Tower Area plots, This area actually had as much greater-than-PAL airborne activity as any other area, however, most of the incidents of greater-than-?AL activity were of the planned and controlled nature, This area was on a "respiratory protection required" status from November 15, 1968 until shut-down in October 1969. Many insidious leaks continually occurred in the system(s) in this area necessitating the wearing of respiratory protection when work was performed. Of the eight greater-than-PAL weeks experienced here, five greater-than-PAL readings were a result of carry-over from releases in other areas; two were caused by equipment failure in the area. The cause of the other one (Week 32, 1969) could not be ascertained after a thorough investigation,

After the Oxide Conversion Facility was shut down in October 1969 it was discovered that the Oxide Unloading Room ventilation fan wqs not operating, It is not known how long this fan had been off. The unloading glove box fan exhausts into the same duct as the room ventilation fan. If there were any holes in the glove box filter system, contaminated air could be blown back into the unloading room with the room ventilation fan off. This could have been part of the cause for the high airborne activity in this area,

F&commendations

1. Chemical Operations plans to upgrade the capacity of the glove box exhaust fan to gain a better differential on the box, In addition, it is suggested that the entire pneumatic system in this area be thoroughly leak tested and repaired as necessary before being reused.

2. The number of times that the pneumatic roughing filter must be changed has been greatly reduced, however, the radiological aspects of changing these filters should be reviewed in regard to preventing the spread of contamination experienced from this operation.

3. A considerable amount of the maintenance work done on the pulverizer over the past two years required the removal of gloves and at the time an entire section of the east side of the box. The pulverizer system is to be modified before start-up, however, it is recommended that the positions of the gloves in this section be changed to better perform the necessary maintenance work utilizing the gloves.

Calciner Area (Graphs 8 and 9)

The assay baing processed was based on the material in the flame tower. The uranium being processed by the calciner may have been at widely different assays. The PAL plot on an equivalent weight basis for the calciner was not adjusted to reflect this difference because the values of the assay on a weekly basis is only approximate, The Calciner Area greater-than -PAL airborne activity was mostly generated by the work activities in this area. Of the seven greater-than-PAL weeks, five were calciner "blow-backs" caused by exhaust fan problems. Of the other two; one was caused by floor decontaminating activity and one was carry-over from a release in the Cold Trap Area.

The wearing of respiratory protection when changing cans (at the calciner) and rodding the calciner was instituted with the start-up of this facility. Mixing batches for the slope tanks initially caused no high airborne problems, however, due to the handling of material of different physical characteristics and higher assays, the wearing of respiratory protection when performing this job started approximately September 1, 1968 and continued until about September 15, 1969 when a glove box was installed over the end of the slope tank. The overall two-year plot of airborne activity has somewhat a different profile than the other areas. The overall first year average was 2.23 $d/m/ft^3$ compared with 0.65 $d/m/ft^3$ for 1969. In 1969 none of the weekly averages were greater than PAL.

Recommendations

1. Now that a glove box has been installed on the mixing end of the slope tank, the highest potential for airborne in the area is the front end of the calciner. It is recommended that some type of hood or other means be employed to provide ventilation here during rodding and blow-backs.

2. The bottle drying rack is another potential source of high airborne activity. The floor under this rack continues to have extremeiy high

wipe activity, It is recommended that an enclosure be built around the rack to contain any possible airborne activity, and keep material off the floor,.

3. The continued high wipe activity on the floor in the Calciner Area is possibly another source of airborne activity. Judicious handling of material and material containers would eliminate part of this problem,

H-Area (Graphs 9 and 10)

This area experienced five weeks of greater-than-PAL activity. Of these, two were caused by a release in the cold trap and one by a burn-out on the flame towers, Of the two incidents originating in H-Area, one was caused by equipment failure and one by an improperly fastened glove box port. The overall 1968 and 1969 averages are approximately the same, with both values below PAL.

Recommendations

A frequent routine inspection of this remote area might have shortened the duration of two of the high airborne weeks experienced in this area.

Summary

On an overall average radiation base the airborne activity in the subject areas was better in 1968 than in 1964, tlowever, on an equivalent weight base, yearly average 1969 was lower than 1968, The following is the summary of these values as well as the average assays.

1968

$d/m/ft^3$	$\mu g/ft^3$	Assay Processed
2.20	4.81	47.8

1969

$d/m/ft^3$	$\mu g/ft^3$	Assay Processed
2.82	2.86	63.8

CALENDAR FOR CONTINUOUS AIR SAMPLES - 1968

Week No.	From	Through	Week No.	From	Through
1	Jan. 1	Jan. 7	27	July 1	July 7
2	Jan. 8	Jan. 14	28	July 8	July 14
3	Jan.15	Jan. 21	29	July 15	July21
4	Jan. 22	Jan. 28	30	July22	July 28
- - - -			- - - -		
5	Jan. 29	Feb. 4	31	July 29	Aug. 4
6	Feb. 5	Feb. 11	32	Aug. 5	Aug. 11
7	Feb. 12	Feb. 18	33	Aug. 12	Aug. 18
8	Feb. 19	Feb. 25	34	Aug. 19	Aug. 25
- - - -			- - - -		
9	Feb. 26	Mar. 3	35	Aug. 26	Sep. 1
10	Mar. 4	Kar. 10	36	Sep. 2	Sep. 8
11	Mar. 11	Mar. 17	37	Sep. 9	Sep. 15
12	Mar. 18	Mar. 24	38	Sep. 16	Sep. 22
13	Nar. 25	Mar. 31	39	Sep. 23	Sep. 29
- - - -			- - - -		
____			____		
14	Apr. 1	Apr. 7	40	Sep. 30	Oct. 6
15	Apr. 8	Apr. 14	41	Oct. 7	Oct. 13
16	Apr. 15	Apr. 21	42	Oct. 14	Oct. 20
17	Apr. 22	Apr. 28	43	Oct. 21	Oct. 27
- - - -			- - - -		
18	Apr. 29	May 5	44	Oct. 28	Nov. 3
19	May 6	May 12	45	Nov. 4	Nov. 10
20	May 13	May 19	46	Nov. 11	Nov. 17
21	Hay 20	Kay 26	47	Nov. 18	Nov. 24
- - - -			- - - -		
22	Kay 27	June 2	48	Nov. 25	Dec. 1
23	June 3	June 9	49	Dec. 2	Dec. 8
24	June10	June 16	50	Dec. 9	Dec. 15
25	June17	June 23	51	Dec. 16	Dec. 22
26	June 24	June 30	52	Dec. 23	Dec. 29
- - - -			- - - -		
____			____		

______ The 13-week periods falling within the solid lines will be included in the quarterly reports for both air samples and film badge change-out.

- - - - The periods falling within the broken lines will. be included in the monthly reports.

Week <u>starts</u> at <u>0001 hours</u> on date designated..

Week <u>ends</u> at <u>2400 hours</u> on date designated.

CALENDAR FOR CONTINUOUS AIR SAMPLES - 1969

Week No.	From	Through	Week No.	From	Through
1	Dec. 30 1968	Jan. 5 1969	27	June 30	July 6
2	Jan. 6	Jan. 12	28	July 7	July 13
3	Jan. 13	Jan. 19	29	July 14	July 20
4	Jan. 20	Jan. 26	30	July 21	July 27
- - - -			- - - -		
5	Jan. 27	Feb. 2	31	July 28	Aug. 3
6	Feb. 3	Feb. 9	32	Aug. 4	Aug. 10
7	Feb. 10	Feb. 16	33	Aug. 11	Aug. 17
8	Feb. 17	Feb. 23	34	Aug. 18	Aug. 24
- - - -			- - - -		
9	Feb. 24	Mar. 2	35	Aug. 25	Aug. 31
10	Mar. 3	Mar. 9	36	Sep. 1	Sep. 7
11	Mar. 10	Mar. 16	37	Sep. 8	Sep. 14
12	Mar. 17	Mar. 23	38	Sep. 15	Sep. 21
13	Mar. 24	Mar. 30	39	Sep. 22	Sep. 28
- - - -			- - - -		
______			______		
14	Mar. 31	Apr. 6	40	Sep. 29	Oct. 5
15	Apr. 7	Apr. 13	41	Oct. 6	Oct. 12
16	Apr. 14	Apr. 20	42	Oct. 13	Oct. 19
17	Apr. 21	Apr. 27	43	Oct. 20	Oct. 26
- - - -			- - - -		
18	Apr. 28	May 4	44	Oct. 27	Nov. 2
19	May 5	May 11	45	Nov. 3	Nov. 9
20	May 12	May 18	46	Nov. 10	Nov. 16
21	May 19	May 25	47	Nov. 17	Nov. 23
- - - -			- - - -		
22	May 26	June 1	48	Nov. 24	Nov. 30
23	June 2	June 8	49	Dec. 1	Dec. 7
24	June 9	June 15	50	Dec. 8	Dec. 14
25	June 16	June 22	51	Dec. 15	Dec. 21
26	June 23	June 29	52	Dec. 22	Dec. 28
- - - -			- - - -		
______			______		

______ The 13-week periods falling within the solid lines will be included in the quarterly reports for both air samples and film badge change-out.

- - - -The periods falling within the broken lines will be included in the monthly reports.

Week starts at 0001 hours on date designated.

Week ends at 2400 hours on date designated.

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

1968 Weeks	Average Assay Processed (Approx.)	PAL at Assay Processed $\mu g/ft^3$ X 10^{-2}	Average Overall $d/m/ft^3$
1	3.0	71.4	1.58
2	5.0	46.9	1.44
3	4.5	51.0	0.19
4	4.0	55.6	0.34
5	4.0	55.6	0.28
6	3.5	62.0	0.47
7	3.5	62.0	0.42
8	3.7	59.0	0.31
9	3.7	59.0	0.28
10	4.1	55.0	0.34
11	3.0	71.4	0.16
12	3.9	57.0	2.68
13	3.9	57.0	0.12
14	4.0	55.6	0.13
15	4.0	55.6	0.11
16	5.5	43.0	0.14
17	9.0	27.8	0.24
18	9.2	27.0	0.36
19	9.3	26.8	0.21
20	12.5	21.0	0.14
21	14.5	18.0	0.24
22	15.5	16.8	0.14
23	17.0	15.3	0.59
24	19.0	13.5	0.25
25	28.2	9.4	0.28
26	20.0	13.2	0.32
27	21.0	12.8	0.27
28	21.0	12.8	0.35
29	91.0	1.8	.6.92
30	91.0	1.8	2.68
31	90.0	1.8	9.88
32	90.0	1.8	0.96
33	90.0	1.8	2.08
34	90.0	1.8	0.63
35	90.0	1.8	0.65
36	90.0	1.8	0.50
37	90.0	1.8	1.31
38	90.0	1.8	0.59
39	90.0	1.8	0.62
40	90.0	1.8	0.90
41	90.0	1.8	9.00
42	90.0	1.8	1.04
43	90.0	1.8	62.19
44	90.0	1.8	1.57

(Continued)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

1968 Weeks	Average Assay Processed (Approx.)	PAL at Assay Processed $\mu g/ft^3$ X 10^{-2}	Average Overall $d/m/ft^3$
45	90.0	1.8	1.69
46	90.0	1.8	6.00
47	90.0	1.8	1.35
48	90.0	1.8	1.75
49	90.0	1.8	3.39
50	90.0	1.8	4.48
51	97.0	1.6	3.52
52	97.0	1.6	1.81
1968 Averages	47.8		

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

1969 Weeks	Average Assay Processed (Approx.)	PAL at Assay Processed /ug/ft3 x 10'2	Average Overall d/m/ft3
1	97.0	1.6	0.97
2	97.0	1.6	1.77
3	97.0	1.6	0.73
4	97.0	1.6	1.94
5	93.0	1.8	0.90
6	93.0	1.8	2.12
7	93.0	1.8	1.09
8	93.0	1.8	55.52
9	93.0	1.8	2.47
10	92.0	1.8	0.89
11	92.0	1.8	28.84
12	88.0	2:0	1.22
13	88.0	2.0	3.91
14	86.0	2.0	2.31
15	70.0	3.3	1.42
16	65.0	3.4	0.78
17	55.0	4.2	1.66
18	55.0	4.2	0.76
19	Strike	Strike	Strike
20	Strike	Strike	Strike
21	55.0	4.2	0.78
22	41.0	6.1	0.55
23	36.0	7.1	1.26
24	30.0	8.8	1.02
25	27.0	9.7	0.70
26	23.0	11.5	0.74
27	28.0	9.4	0.72
28	28.0	9.4	0.86
29	28.0	9.4	1.22
30	28.0	9.4	0.79
31	85.0	2.1	0.51
32	85.0	2.1	8.64
33	85.0	2.1	1.29
34	85.0	2.1	1.35
35	85.0	2.1	0.72
36	20.0	13.2	0.75
37	6.0	40.0	0.63
38	6.0	40.0	0.69
39	3.0	71.4	0.61
40	95'0	1.6	1.41
1969 Average	63.8		

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

Cold Trap

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$	1969 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$
1	0.818	19.40	1	0.92	0.56
2	1.062	16.59	2	3.06	1.85
3	0.225	3.75	3	1.20	0.73
4	0.396	7.33	4	2.61	1.58
5	0.395	7.31	5	1.18	0.74
6	0.465.	9.69	6	2.26	1.41
7	0.437	9.10	7	1.21	0.76
8	0.174	3.48	8	17.70	11.06
9	0.178	3.56	9	5.60	3.50
10	0.178	3.24	10	1.97	1.61
11	0.159	3.79	11	107.08	88.36
12	0.737	14.17	12	1.64	1.41
13	0.104	2.00	13	12.37	10.66
14	0.177	3.28	14	7.13	5.06
15	0.155	2.87	15	1.25	1.14
16	0.087	1.24	16	0.53	0.56
17	0.124	1.18	17	3.10	4.43
18	0.316	2.95	18	1.62	2.31
19	0.151	1.37	19	Strike	Strike
20	0.074	0.53	20	Strike	Strike
21	0.203	1.26	21	0.50	0.71
22	0.146	0.83	22	0.28	0.51
23	0.313	1.61	23	2.62	5.95
24	0.260	1.21	24	1.37	3.61
25	0.125	0.39	25	0.55	1.67
26	0.415	1.80	26	0.42	1.40
27	0.102	0.43	27	0.27	0.96
28	0.123	0.51	28	0.61	2.18
29	11.725	9.02	29	0.80	2.86
30	2.985	2.30	30	0.64	2.29
31	4.282	3.57	31	0.84	0.34
32	0.594	0.50	32	28.81	20.49
33	0.362	0.30	33	1.56	1.11
34	0.189	0.16	34	1.20	0.85
35	0.448	0.34	35	1.07	0.76
36	0.238	0.18	36	0.39	1.63
37	3.160	2.39	37	0.48	6.32
38	0.433	0.34	38	0.44	5.79
39	0.188	0.14	39	0.62	14.09
40	0.154	0.12	40	0.59	0.40
41	0.342	0.26	1969 Average	5.70	5.57
42	0.278	0.21			
43	109.100	82.65			
44	3.215	2.44			

(1968 continued on next page.)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES
Cold Trap (Continued)

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$
45	1.635	1.24
46	12.680	9.61
47	1.805	1.37
48	1.800	1.36
49	1,760	1.33
50	6.873	5.21
51	9.110	5.52
52	4.530	2.75
1968 Averages	3.58	4.96

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES
Tower Room

1968 Weeks	d/m/ft^3	$\mu g/ft^3 \times 10^{-2}$	1969 Weeks	d/m/ft^3	$\mu g/ft^3 \times 10^{-2}$
1	2.759	65.69	1	1.41	0.85
2	2.050	32.03	2	2.13	1.29
3	0.171	2.83	3	2.51	1.52
4	0.226	4.19	4	2.60	1.58
5	0.204	3.78	5	1.11	0.69
6	0.381	7.94	6	1.83	1.14
7	0.218	4.54	7	1.57	0.98
8	0.180	3.60	8	118.55	7.41
9	0.215	4.30	9	0.60	3.75
10	0.201	3.66	10	0.28	0.23
11	0.101	2.40	11	3.48	2.85'
12	4.658	89.58	12	1.27	1.08
13	0.137	2.63	13	1.23	1.06
14	0.162	3.00	14	0.60	0.43
15	0.045	0.83	15	2.09	1.90
16	0.107	1.53	16	0.83	0.87
17	0.168	1.60	17	1.05	1.50
18	0.256	2.39	18	0.51	0.73
19	0.148	1.35	19	Strike	Strike
20	0.101	0.72	20	Strike	Strike
21	0.152	0.95	21	0.89	1.27
22	0.124	0.71	22	0.66	1.20
23	0.224	1.15	23	0.85	1.93
24	0.191	0.89	24	1.11	2.92
25	0.276	0.86	25	0.79	2.39
26	0.368	1.60	26	1.17	3.90
27	0.190	0.79	27	0.74	2.64
28	0.210	0.87	28	1.27	4.54
29	7.556	5.81	29	0.86	3.07
30	2.660	2.05	30	1.07	3.82
31	3.633	3.03	31	0.70	0.50
32	0.835	0.70	32	1.77	1.26
33	0.616	0.51	33	1.62	1.15
34	1.207	1.00	34	1.02	0.72
35	1.091	0.83	35	0.69	0.49
36	0.824	0.62	36	1.22	5.08
37	0.899	0.68	37	0.89	11.71
38	0.806	0.61	38	0.86	11.32
39	0.890	0.67	39	0.73	16.69
40	1.555	1.18	40	2.71	1.83
41	18.878	14.30	1969 Average	4.35	2.85
42	1.161	0.88			
43	89.706	67.96			
44	0.860	0.65			

(1968 continued on next page.)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES
Tower Room (Continued)

1968 Weeks	d/m/ft^3	μg/ft^3 x 10^{-2}
45	2.220	1.68
46	5.160	3.91
47	1.450	1.10
48	2.820	2.14
49	6.966	5.28
50	9.443	7.15
51	2.426	1.47
52	10.113	0.67
1968 Averages	3.37	7.14

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

Oxide Unloading

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$	1969 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$
1	2.390	56.90	1	0.72	0.44
2	2.176	34.00	2	0.59	0.36
3	0.314	5.23	3	0.71	0.43
4	0.278	5.15	4	0.53	0.32
5	0.168	3.11	5	0.50	0.31
6	0.488	10.17	6	1.89	1.18
7	0.923	19.23	7	0.85	0.53
8	1.173	23.46	8	36.07	2.26
9	0.152	3.04	9	1.05	0.66
10	0.168	3.05	10	0.64	0.52
11	0.082	1.95	11	1.34	1.10
12	0.869	16.71	12	1.06	0.91
13	0.031	0.60	13	1.02	0.88
14	0.073	1.35	14	0.68	0.48
15	0.035	0.65	15	0.97	0.88
16	0.052	0.74	16	1.40	1.47
17	0.072	0.69	17	1.74	2.49
18	0.198	1.85	18	0.73	1.04
19	0.095	0.86	19	Strike	Strike
20	0.093	0.66	20	Strike	Strike
21	0.089	0.54	21	0.84	1.20
22	0.096	0.55	22	0.91	1.65
23	0.222	1.14	2 3	0.91	2.07
24	0.153	0.71	24	0.96	2.53
25	0.162	0.51	25	0.67	2.03
26	0.124	0.54	26	0.45	1.50
27	0.225	0.94	27	2.44	8.71
28	0.152	0.63	28	0.79	2.82
29	6.300	4.85	29	4.86	17.36
30	1.070	0.82	30	0.93	3.32
31	1.847	1.54	31	0.50	0.35
32	0.831	0.69	32	3.69	2.62
33	0.535	0.27	33	1.12	0.79
34	0.230	0.18	34	4.04	2.87
35	0.347	0.26	35	0.72	0.51
36	0.221	0.17	36	0.28	1.17
37	0.597	0.45	37	0.79	10.39
38	0.346	0.26	38	1.52	20.00
39	1.171	0.89	39	0.86	19.55
40	0.643	0.49	40	0.57	0.39
41	7.000	5.30	1969		
42	1.564	1.18	Averages	2.11	3.10
43	3.160	2.39			
44	1.54	1.17			

(1968 continued on next page.)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

Oxide Unloading (Continued)

1968 Weeks	d/m/ft^3	μg/ft^3 X 10^{-2}
45	1.39	1.05
46	1.31	0.99
47	0.55	0.42
48	0.67	0.51
49	0.54	0.41
50	2.53	1.92
51	0.78	0.47
52	0.77	0.47
1968 Averages	1.11'	4.40

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

Calciner

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3$ x 10^{-2}	1969 Weeks	$d/m/ft^3$	$\mu g/ft^3$ x 10^{-2}
1	0.116	2.76	1	0.54	0.33
2	0.473	7.39	2	0.29	0.18
3	0.141	2.35	3	0.33	0.20
4	0.168	3.11	4	1.17	0.71
5	0.230	4.26	5	0.52	0.33
6	0.400	8.33	6	0.47	0.29
7	0.293	6.10	7	0.33	0.21
8	0.328	6.56	8	1.32	0.83
9	0.355	7.10	9	0.49	0.31
10	1.225	22.27	10	0.47	0.39
11	0.425	10.12	11	1.19	0.98
12	3.205	61.63	12	1.07	0.92
13	0.060	1.15	13	1.31	1.13
14	0.104	1.92	14	1.39	0.99
15	0.352	6.51	15	0.88	0.80
16	0.562	8.03	16	0.58	0.61
17	0.414	3.94	17	0.82	1.17
18	1.612	15.06	18	0.32	0.46
19	0.290	2.64	19	Strike	Strike
20	0.307	2.19	20	Strike	Strike
21	0.435	2.64	21	0.47	0.67
22	0.171	0.98	22	0.31	0.56
23	0.198	1.02	23	0.53	1.20
24	0.590	2.74	24	0.57	1.50
25	0.519	1.62	25	0.60	1.82
26	0.307	1.33	26	0.32	1.07
27	0.808	3.37	27	0.25	0.89
28	1.55	6.45	28	0.83	2.96
29	1.22	0.94	29	0.46	1.64
30	5.81	4.47	30	0.47	1.68
31	10.80	50.66	31	0.31	0.22
32	3.00	2.50	32	0.74	0.52
33	1.11	0.92	33	0.53	0.38
34	0.60	0.50	34	0.96	0.68
35	0.31	0.24	35	0.42	0.30
36	0.64	0.48	36	0.97	4.04
37	0.67	0.51	37	0.46	6.05
38	0.98	0.74	38	0.41	5.39
39	0.56	0.43	39	0.43	9.77
40	1.35	1.02	40	1.01	0.68
41	6.92	5.24	1969		
42	2.29	1.74	Averages	0.65	1.39
43	3.97	3.01			
44	1.29	0.98			

(1968 continued on next page.)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES'

Calciner (Continued)

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$
45	1.53	1.16
46	4.55	3.45
47	0.60	0.45
48	0.33	0.25
49	0.30	0.23
50	1.65	1.25
51	0.44	0.27
52	0.39	0.24
1968 Averages	2.23	5.49

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES

H - Area

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3$ X 10^{-2}	1969 Weeks	$d/m/ft^3$	$\mu g/ft^3$ X 10^{-2}
1	0.247	5.88	1	0.45	0.27
2	0.598	0.34	2	0.74	0.45
3	0.084	1.40	3	0.45	0.27
4	0.237	4.39	4,	0.82	0.50
5	0.107	1.98	5	0.45	0.28
6	0.144	3.00	6	4.62	2.89
7	0.112	2.33	7	0.37	0.23
8	0.063	1.26	8	15.74	9.84
9	0.015	0.03	9	5.23	3.27
10	0.079	1.44	10	1.22	1.00
11	0.002	0.05	11	3.66	3.00
12	1.500	28.85	12	0.54	0.47
13	0.015	0.29	13	0.53	0.46
14	0.013	0.24	14	0.36	0.26
15	0.019	0.35	15	0.72	0.65
16	0.019	0.27	16	0.71	0.75
17	0.200	2.85	17	1.38	1.97
18	0.079	0.74	18	0.26	0.37
19	0.076	0.69	19	Strike	Strike
20	0.033	0.24	20	Strike	Strike
21	0.035	0.21	21	1.26	1.80
22	0.046	0.26	22	0.65	1.18
23	2.864	14.69	23	0.85	1.93
24	0.179	0.83	24	0.53	1.39
25	0.110	0.34	25	0.88	2.67
26	0.072	0.31	26	0.84	2.80
27	0.070	0.29	27	0.21	0.75
28	0.118	0.49	28	0.25	0.89
29	1.680	1.29	29	0.24	0.88
30	0.590	0.45	30	0.41	1.46
31	0.696	0.58	31	0.19	0.13
32	0.128	0.11	32	1.61	1.14
33	11.386	9.49	33	0.68	0.48
34	0.236	0.20	34	0.33	0.23
35	0.337	0.26	35	0.40	0.28
36	9.147	0.11	36	0.32	1.33
37	0.215	0.16	37	0.16	2.11
38	0.106	0.08	38	0.14	1.84
39	0.211	0.16	39	0.12	2.73
40	0.193	0.15	40	0.41	0.28
41	0.790	0.60	1969		
42	0.386	0.29	Averages	1.28	1.40
43	3.090	2.34			
44	0.73	0.55			

(1968 continued on next page.)

CONTINUOUS AIR SAMPLE RESULTS - WEEKLY AVERAGES
H - Area (Continued)

1968 Weeks	$d/m/ft^3$	$\mu g/ft^3 \times 10^{-2}$
45	0.70	0.53
46	1.26	0.95
47	0.70	0.53
48	0.95	0.72
49	1.84	1.39
50	1.91	1.45
51	1.40	0.85
52	0.89	0.54
1968 Averages	.72	2.04